Leads detection using SARAL/AltiKa - Comparison with Modis segmented data

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Objectives

Improvement of two fundamental parameters for global climate studies

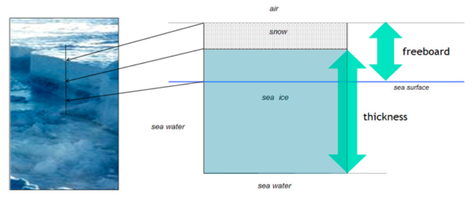
- **Arctic sea mean level**
- **Seaice volums**

Climatology of these parameters over the 15 years of the altimetry

- ERS1 & 2 (ku band) : 1991 - 2002
- Envisat (ku band) : 2002 - 2010
- Cryosat2 (ku band, SAR-altimetry) : 2010-…
- **Saral/Atika (ka band)** : 2013-…
- Sentinel 3 (ku band, SAR altimetry) : *2015-…*

Methodology:

1. Leads localisation
2. Mesurement of sealevel in leads and polynyas and of the seaice height
3. Computation of freeboards
4. Deduction of volums using knowledges relative to:
   - ice density (through ice age)
   - snow depth,
   - seaice surface spreads

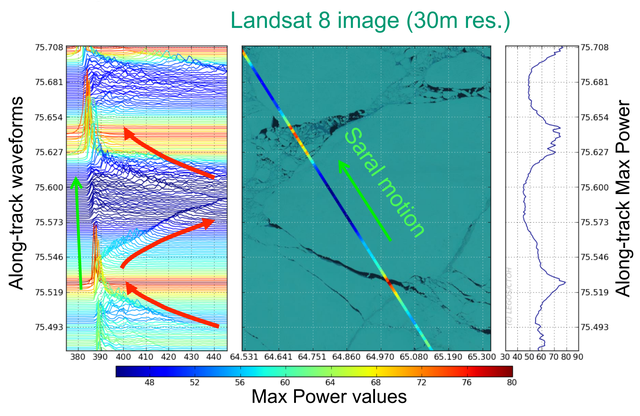


Data and Method

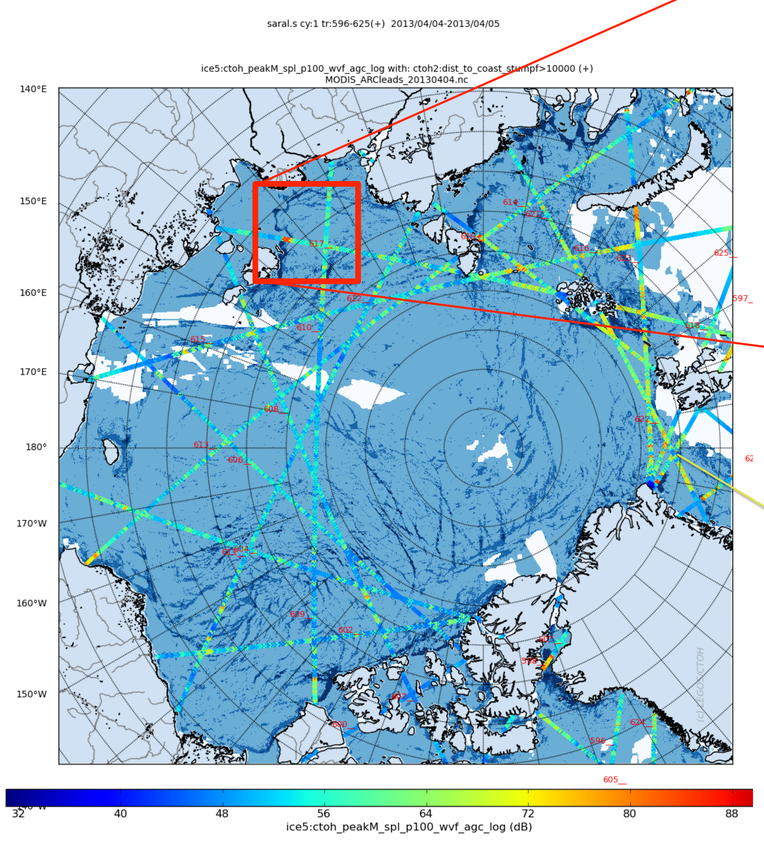
Some MODIS/TIR & Saral/AltiKa caracteristics

	MODIS/TIR	SARAL/AltiKa
Physics	T°	Wvf (backscatter) + height
Spatial resolution	1km	170m (footprint 4km)
Spatial coverage	90°N	82°N
Limitations	Clouds	Melting-pounds
	Superficially freezed water	
	Melting-pounds	
Period	daily	monthly

Principle of leads detection with Saral/AltiKA



A one day map of MODIS/TIR segmented data, with about 30 SARAL tracks colocalized on the same day



zoom

land

seaice

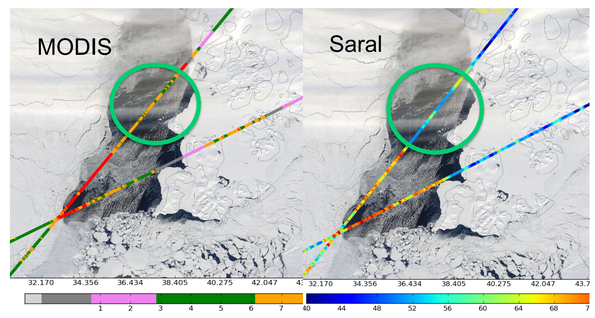
Probable leads

leads

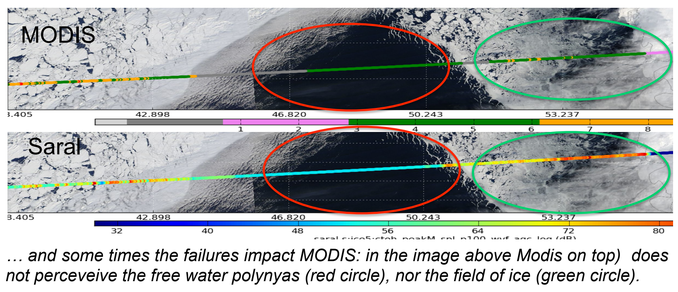
Colocalized Saral tracks.
The color codes the value of the backscatter along-track.

We have good agreements between the strong backscatters of Saral/Altika altimeter and the leads segmented within MODIS/ TIR images.

Some visual checkings on Modis VNIR images
http://earthdata.nasa.gov/data/near-real-time-data/visualization/worldview



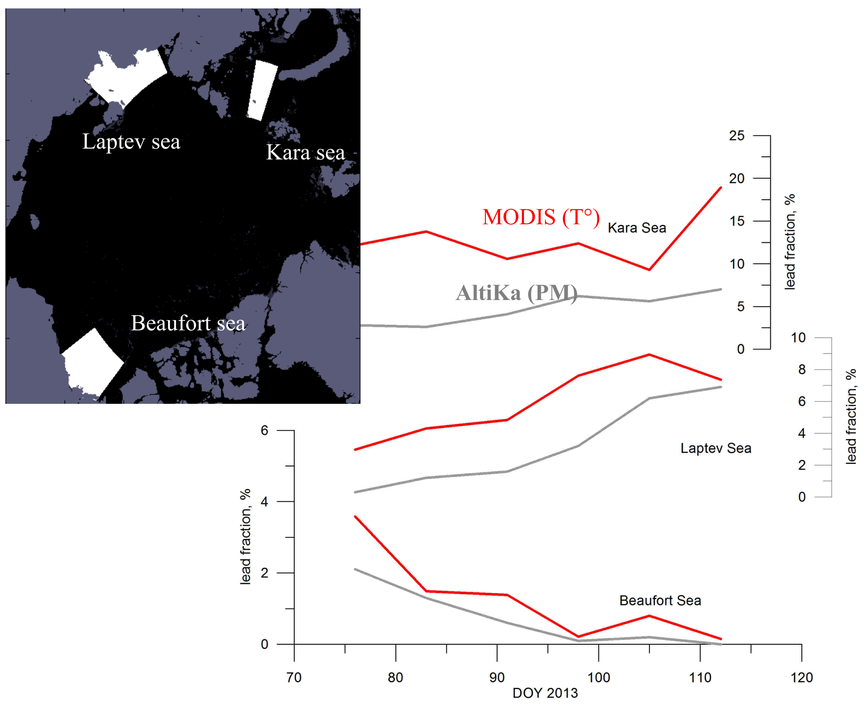
Some times Saral/AltiKA failed: on left image, the polynyas above is detected as a 'sure' lead or a probable lead (green circle), wheras Saral (on the right image) does not see it, according to the Maximum Power criteria. It is well known limitation of the approch. Indeed MP over free-water is between 48 to 55.



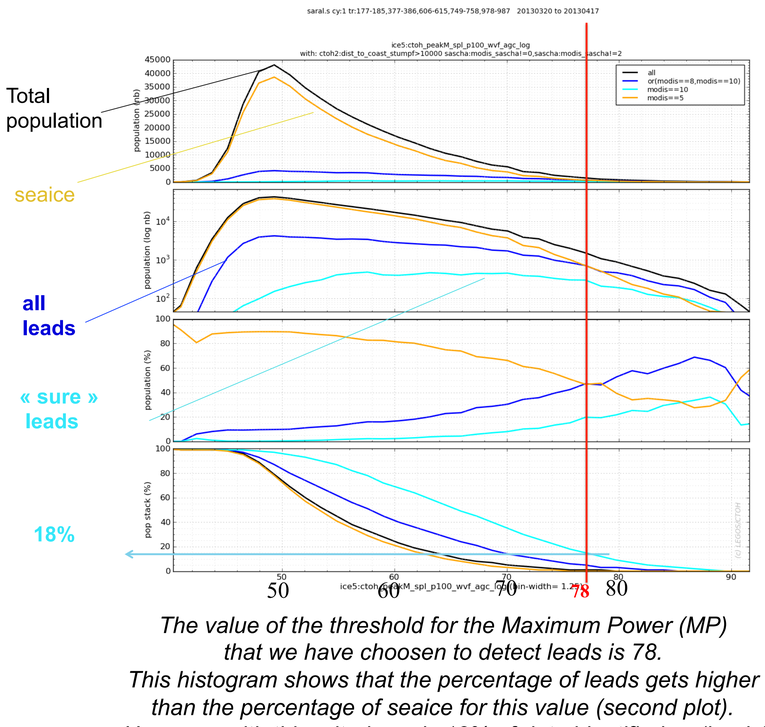
… and some times the failures impact MODIS: in the image above Modis on top) does not perceveive the free water polynyas (red circle), nor the field of ice (green circle).

Results and Discussion

Good agreements between Saral and Modis for the leads Concentration and dynamics at regional level:



… but along-track discrepancies:

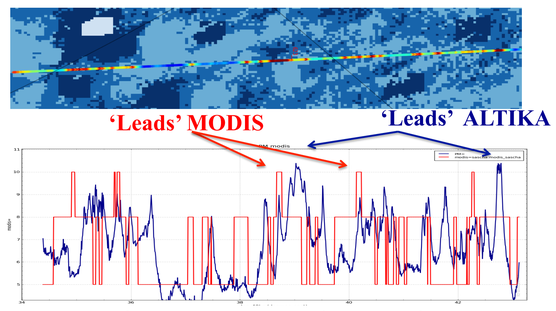


The value of the threshold for the Maximum Power (MP) that we have choosen to detect leads is 78.
This histogram shows that the percentage of leads gets higher than the percentage of seaice for this value (second plot).
However, with this criteria, only 18% of data identified as 'leads' by Modis are also detected as leads by Saral (bottom plot).

Possible causes of discrepancy

- From spatial resolution:
  - MODIS: can miss small leads (<1km)
  - MODIS: can miss leads/polynyas along coast
- From measurement technics:
  - MODIS: can miss re-frozen (thermic isolation of free-water)
  - SARAL: can mixed-up free-water of large polynyas with seaice
  - SARAL is more sensitive to the edges of the leads
  - (still water with strong backscatter) while
  - MODIS is more sensitive to the centers of the leads with
  - Higher temperature contrasts with the seaice

Along-track discrepencies



Impact of the resolution and/or target favours:
Both methods observe the leads but not at the same time.
-> instantaneous observation is not always coherent
-> the coherency is maintained "in average"

Conclusion

The **difficulties to obtain reliable and large reference dataset on seaice** claims for **inter comparision and validation** of the measurments and observations.
This study has demonstrated the contribution of such analysis.
The **key role of seaice on the climate** should make such collaborations even more precious.

Need for collaborations for:

- Snow depth
- Type/age of ice (density)
- Spatial

Multi-sensors (passive/active) synergy is need to detect and to measure the geometry of the leads and polynyas (freeboard, length, distributions).
distribution of the ice field structure

On going work:

- Improvement of leads detection using altimetry for the various technologies :
  - ka/ku bands
  - nadir SAR (cryosat2)
- Measurement of sea level and seaice heights using adapted retracker.
- Multi-missions mesurement to improve the coverage